Klamath River Benthic Algae Monitoring
Iron Gate Dam to Turwar: 2004

Presented by:

North Coast Regional Water Quality Control Board

Yurok Tribe

Watercourse Engineering, Inc.

Participants

- North Coast Regional Water Quality Control Board
- Yurok Tribe Environmental Program
- Watercourse Engineering, Inc.
- Aquatic Analysts
- MaxDepth Aquatics
- Financial Support from:
  - PacifiCorp
  - U.S. EPA
- Other Data Sources
  - USFWS
  - USGS

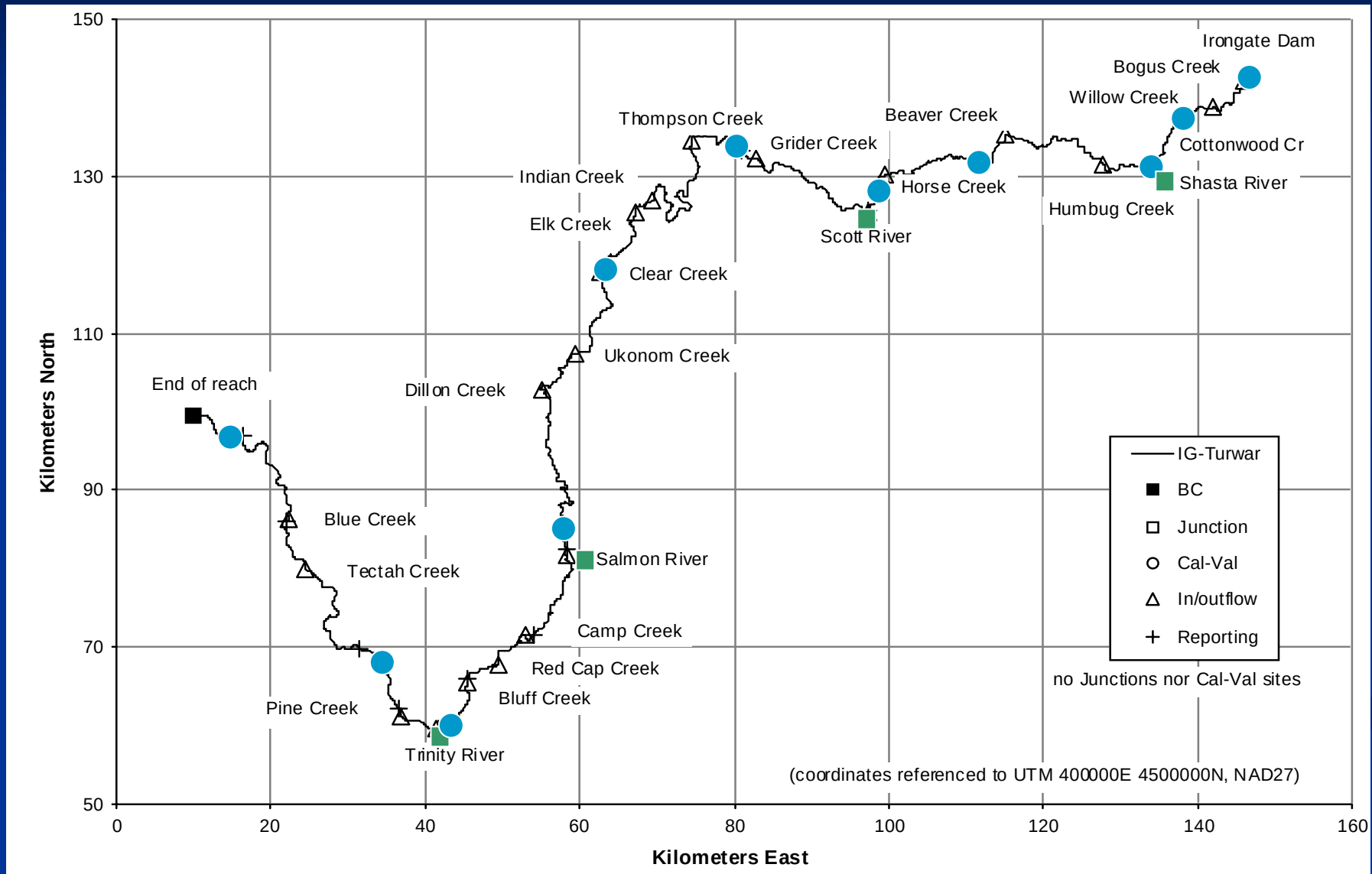
Outline

- Study methods & overview
- Focus on six algal species
- Distribution graphs
- Conclusions
- References

Study Methods & Overview

- 15 sampling sites from IGD to Turwar
- July: Yurok & NCRWQCB; Aug: Yurok & Watercourse; Sept: Yurok & MaxDepth
- Uniform methods and analyses
- Similar microhabitats at sample locations:
  - 1 – 2 ft depth
  - 1 – 2 ft/sec velocity
  - Minimal topographic and riparian shade
- Collected 3 samples at each monitoring location:
  - Speciation
  - Enumeration – density and biovolume
  - Biomass – AFDM, Chl a & Pheophyton a

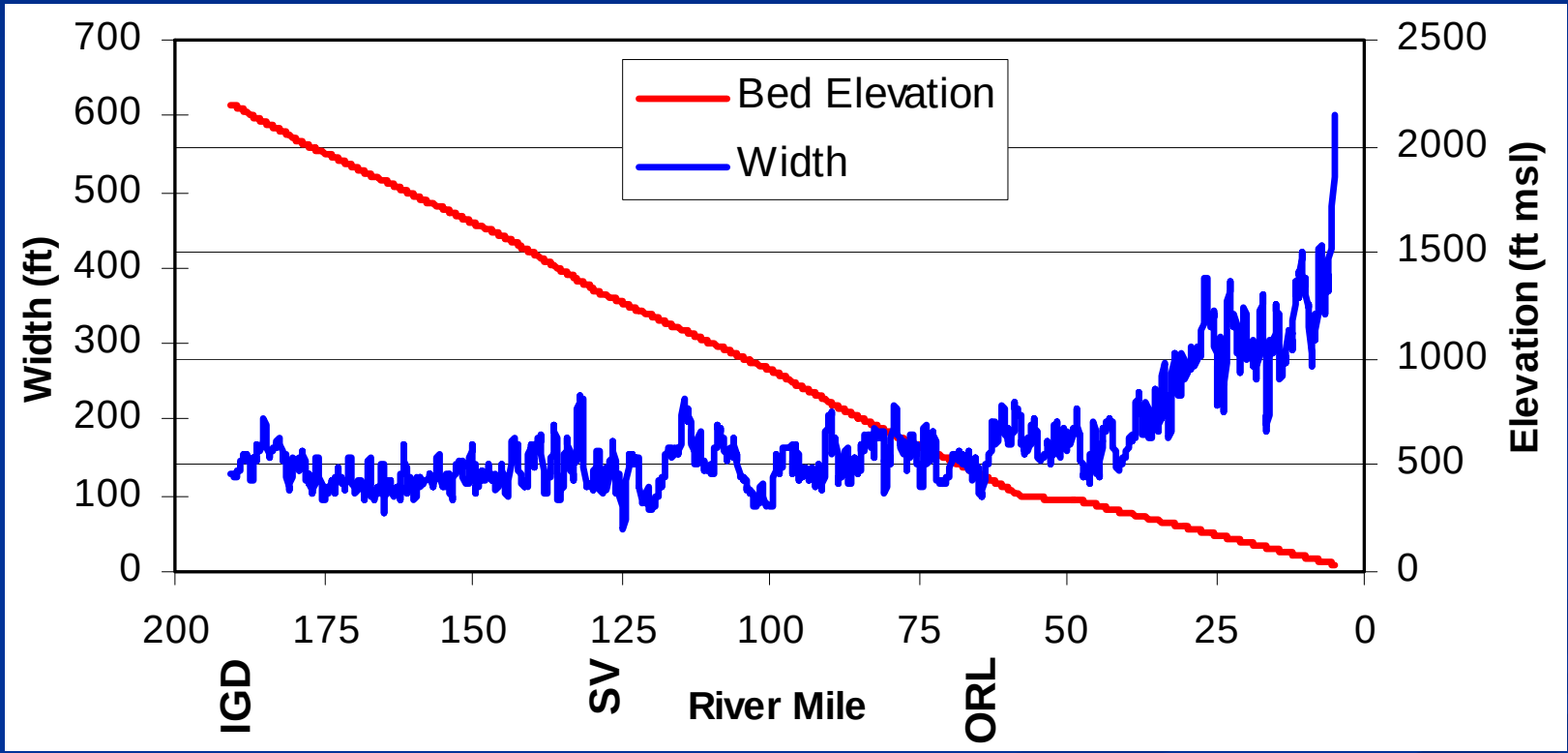
Klamath River from Iron Gate Dam to Turwar



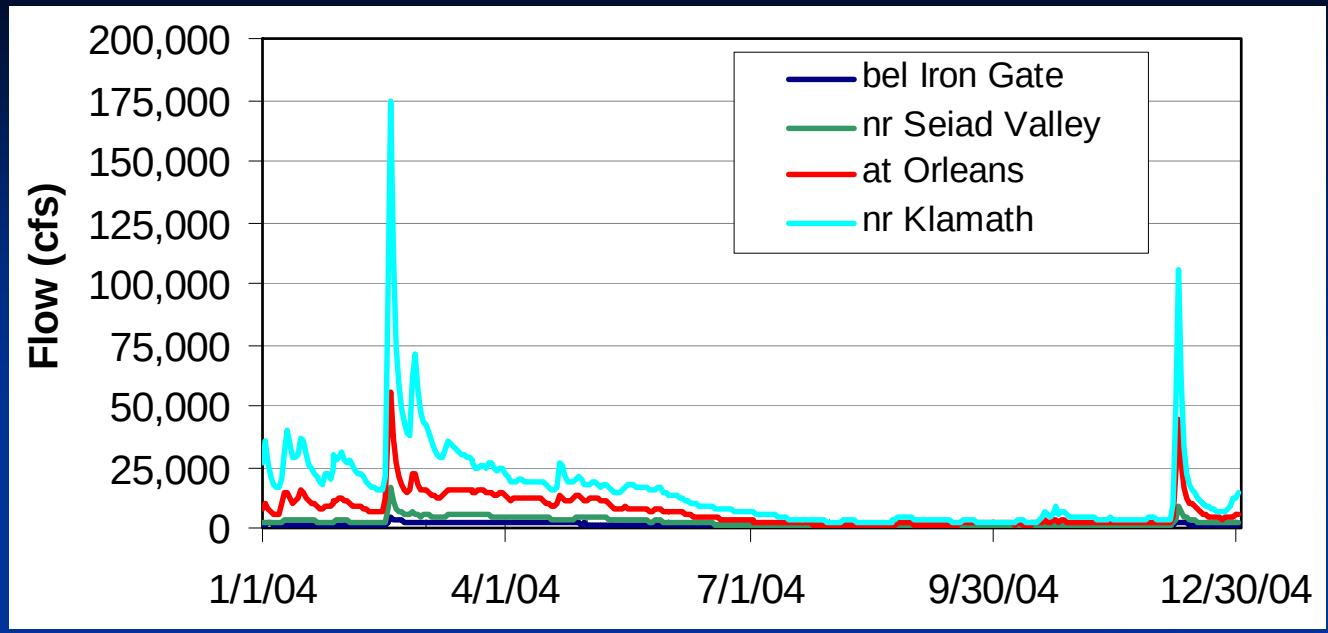
Study Methods & Overview

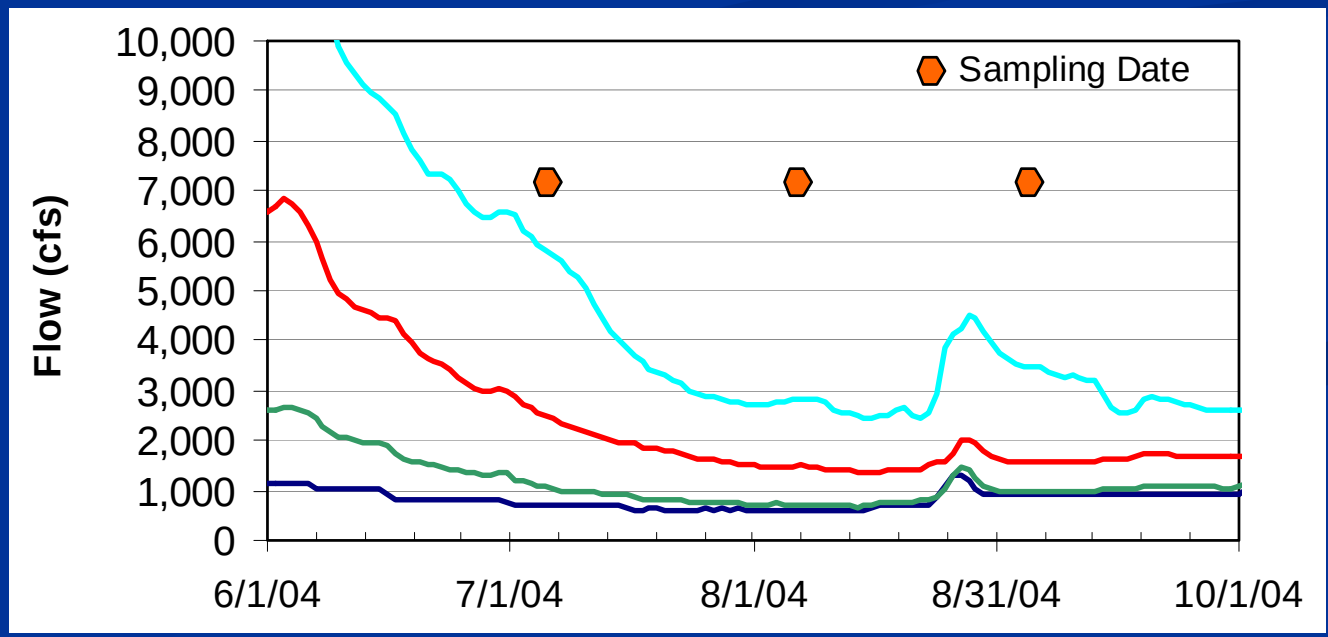
- Species density and biomass were determined for each site
- Examined data collected in July, August, and September, 2004
- Sorted species by percentage density from each site and six species appeared more frequently than others (>25%).
  - *Cymbella affinis* (CMAF)
  - *Cocconeis placentula* (COPC)
  - *Diatoma vulgare* (DTVL)
  - *Epithemia sorex* (EPSX)
  - *Navicula cryptocephala veneta* (NVCV)
  - *Nitzschia frustulum* (NZFR)

River Gradient and Width

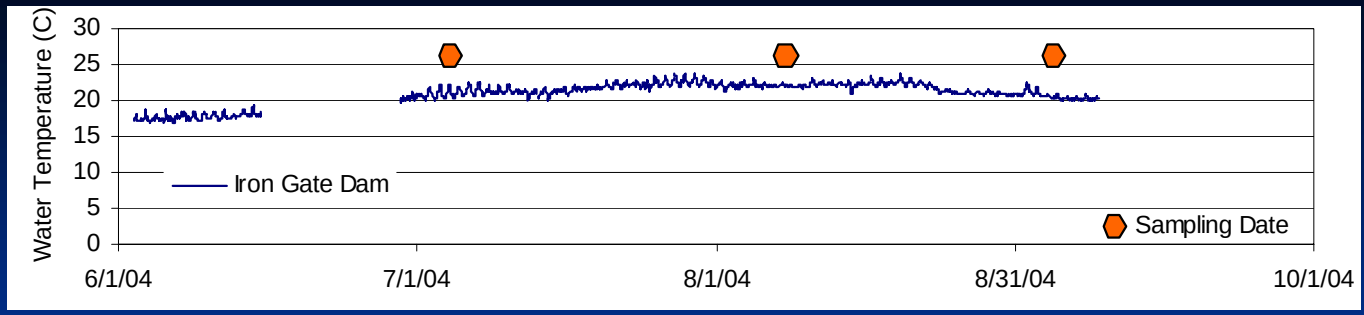


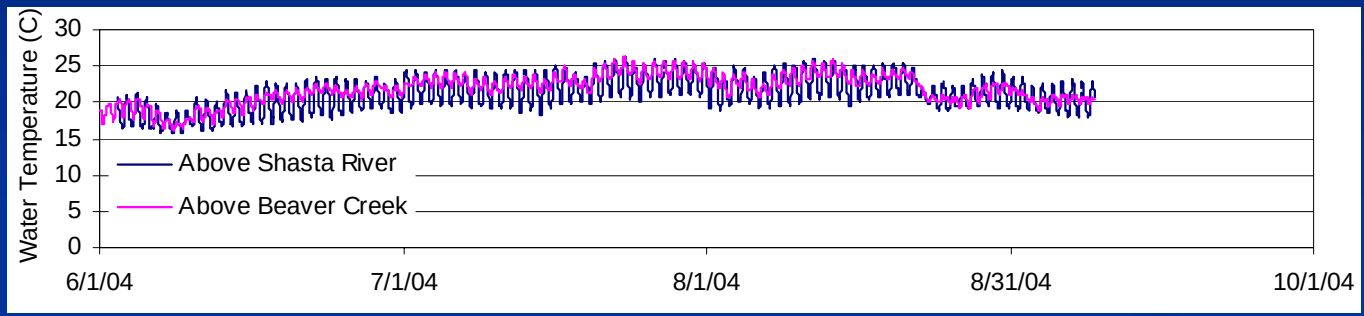
Flow Regime (USGS)

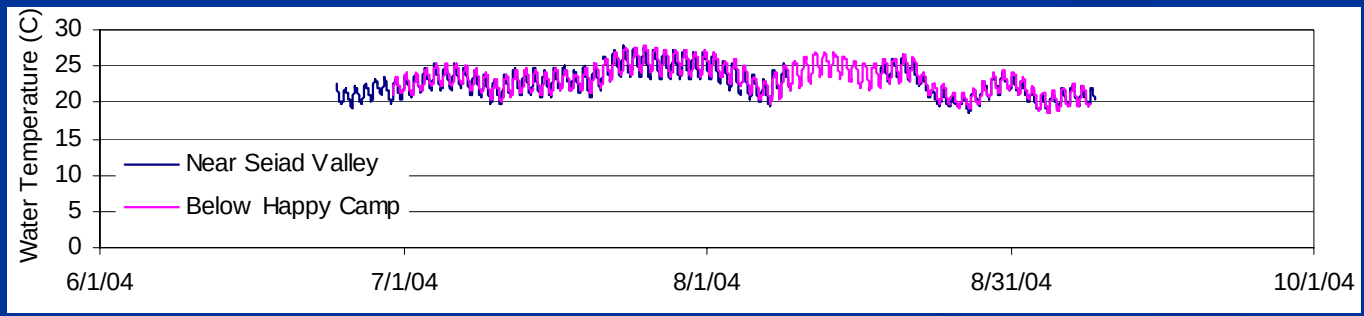


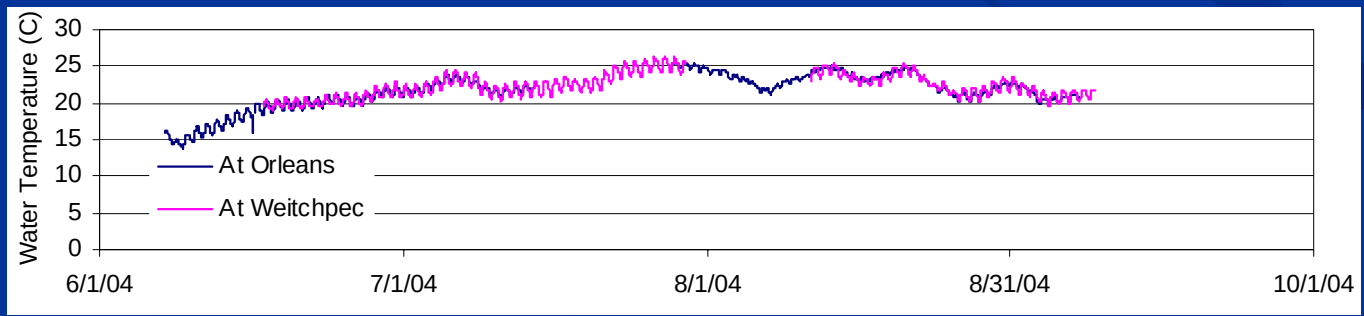


Water Temp. (USFWS)

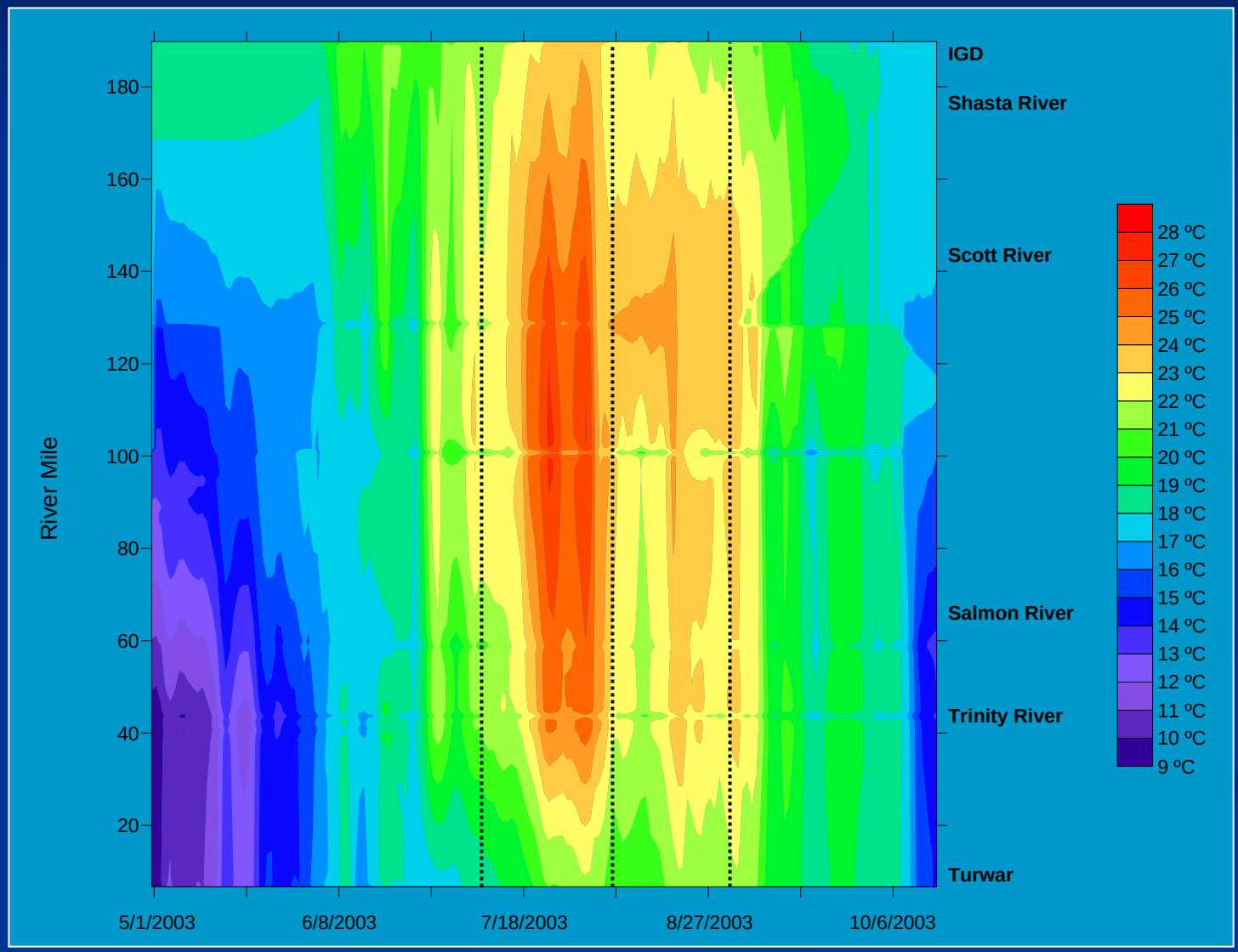






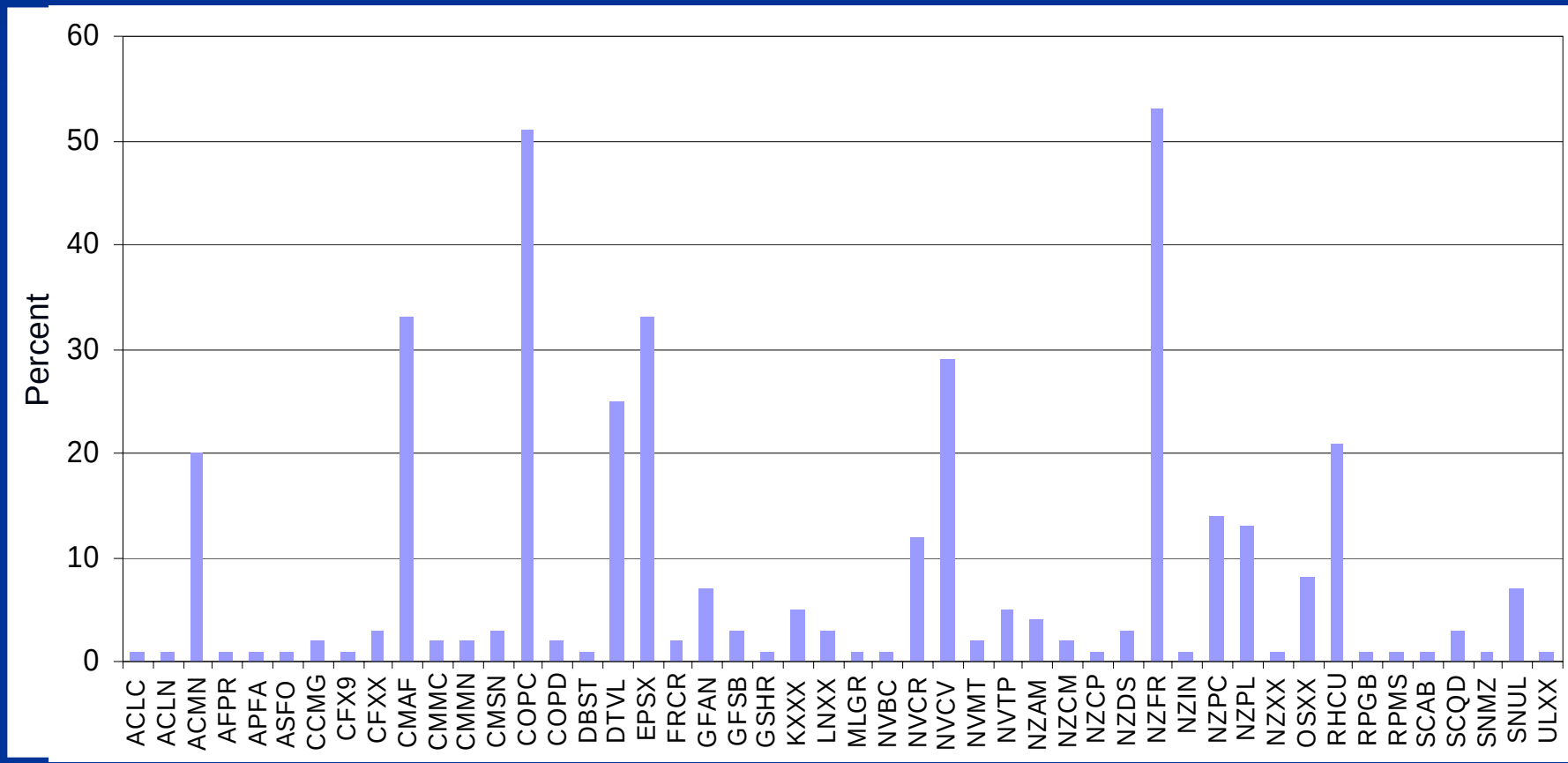


Water Temperature from Iron Gate Dam to Turwar (2003*)



Algae Frequency

Species Falling Within the Top Five Percent
– Predominantly Diatoms –

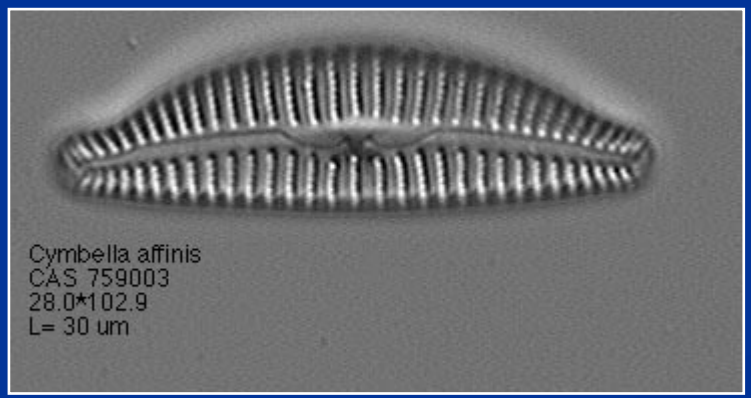


Dominant Algal Species

- Sorted species by percentage density from each site and six species appeared more frequently than others (>25%).
  - *Cymbella affinis* (CMAF)
  - *Cocconeis placentula* (COPC)
  - *Diatoma vulgare* (DTVL)
  - *Epithemia sorex* (EPSX)
  - *Navicula cryptocephala veneta* (NVCV)
  - *Nitzschia frustulum* (NZFR)

Cymbella affinis (CMAF)

- Alkaliphilic (prefers, or can tolerate, alkaline conditions, typically in the range of pH 8-11) with wide distribution in lakes and streams (Patrick & Reimer, 1975).
- In less enriched streams, stalked and tube-dwelling diatoms such as *Cymbella affinis* can dominate (Biggs and Hickey, 1994; Biggs, 1995).
- USGS Classification: eutrophic, alkaliphilic

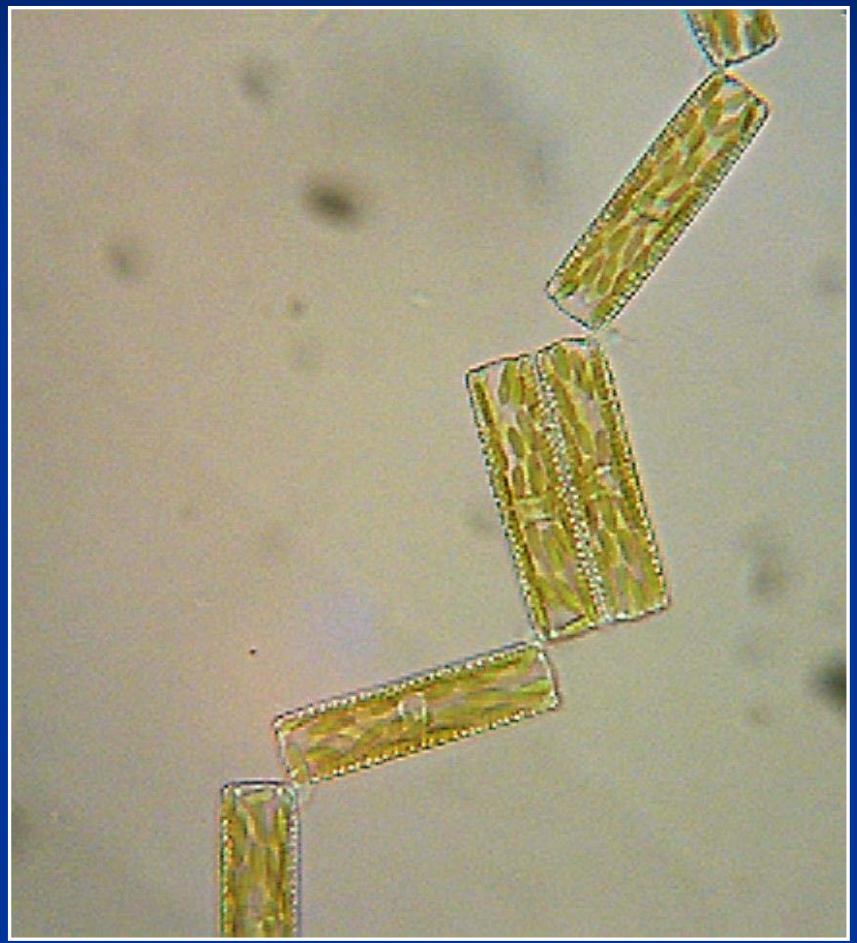


CAS Special Collections

Cocconeis placentula (COPC)

- The most common species found.
- Prefers alkaline and eutrophic water (Fore and Grafe, 2002).
- Prefers higher temperatures (DeNicola, 1996).
- USGS Classification: eutrophic, alkaliphilic

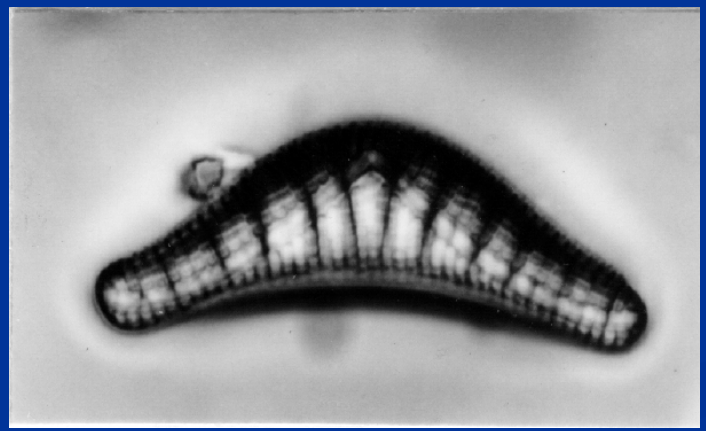
Diatoma vulgare (DTVL)



- This taxon prefers cool, non-stagnant waters with a high nutrient content (Patrick and Reimer 1966).
- Prefers alkaline water (Fore and Grafe, 2002).
- USGS Classification: eutrophic, alkaliphilic

Epithemia sorex (EPSX)

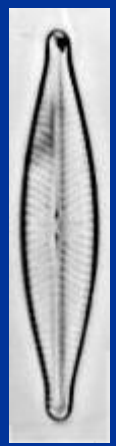
- This taxon is often found in waters of high nutrient content and prefers cool, flowing waters (Patrick and Reimer 1966).
- Prefers alkaline water (Fore and Grafe, 2002).
- Nitrogen limitation favored (Borchardt, 1996).
- USGS Classification: nitrogen fixers, eutrophic, alkaliphilic



***Epithemia sorex* at Weitchpec.**

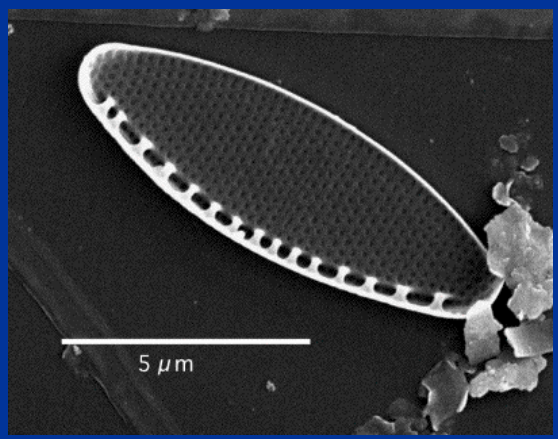
Navicula cryptocephala veneta (NVCV)

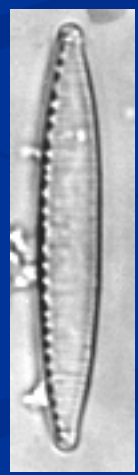
- Species seems to prefer brackish water; also found in fresh water with high mineral content (Patrick and Reimer, 1966).
- Can dominate persistent algal residues after severe scour events, i.e., disturbance (Rounick and Gregory, 1981; Peterson and Hoagland, 1990; Blenkinsopp and Lock, 1994).
- USGS Classification: eutrophic, alkaliphilic, motile (sediment tolerant)



Nitzschia frustulum (NZFR)

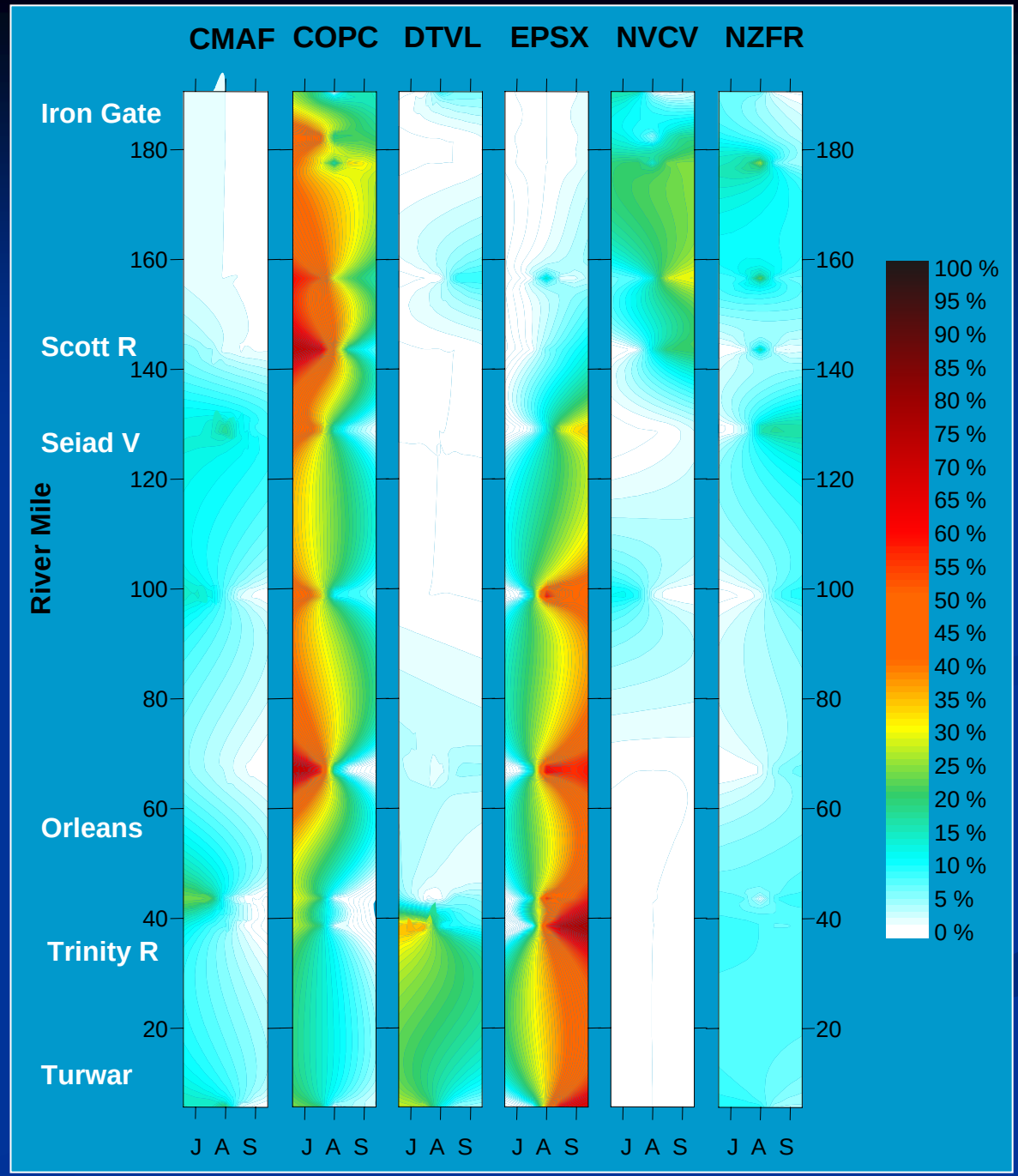
- This species is motile (sediment tolerant) (Fore and Grafe, 2002).
- It's abundance, in certain places, can be linked with facultative heterotrophy (Stevenson and Stoermer, 1981).
- Like warmer temperatures (DeNicola, 1996).
- USGS Classification: eutrophic, alkaliphilic, facultative nitrogen heterotrophs, silt tolerant



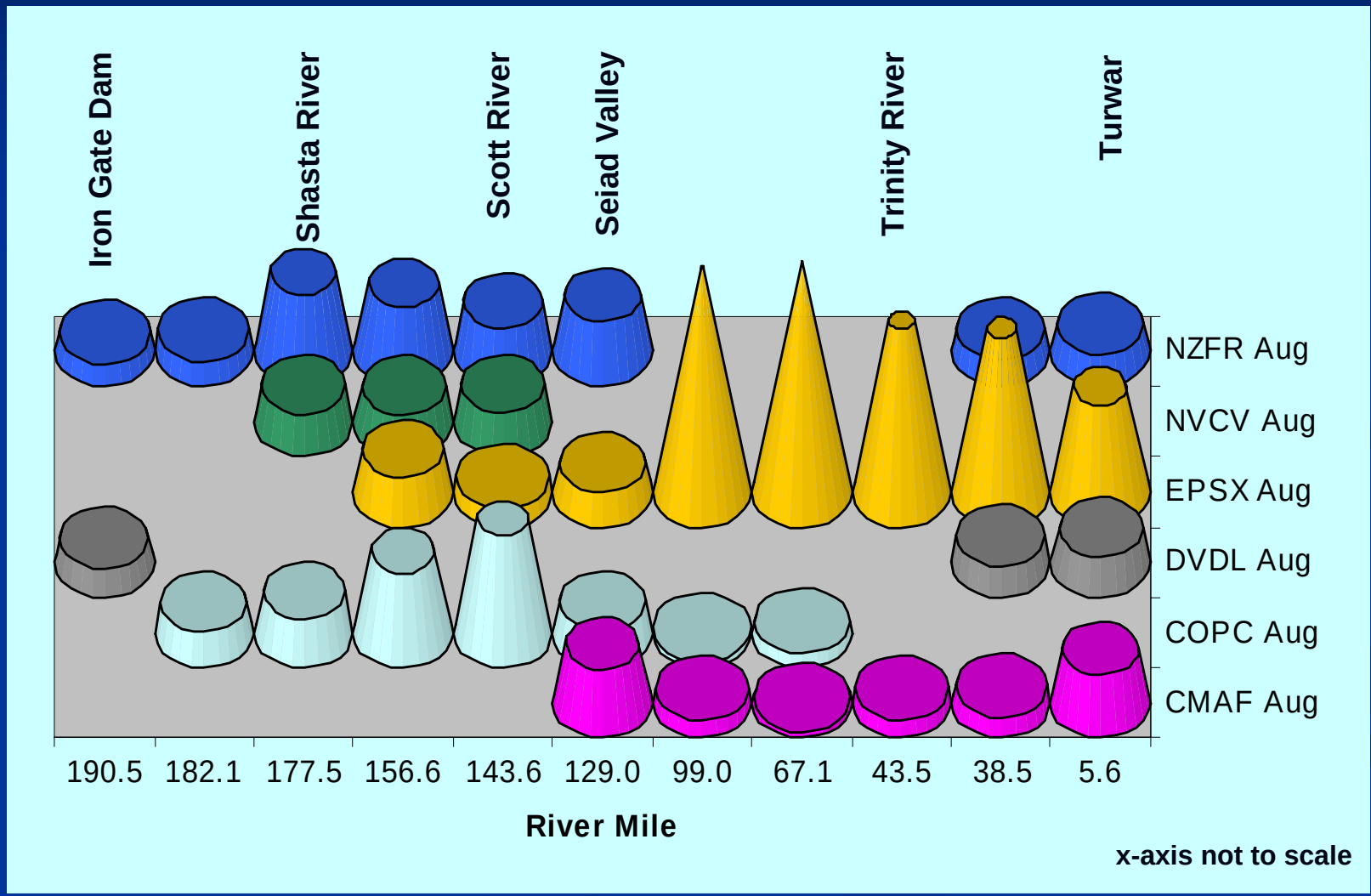


Spatial and Temporal Distribution

Species distribution (by total density) for July, August, and September, 2004.

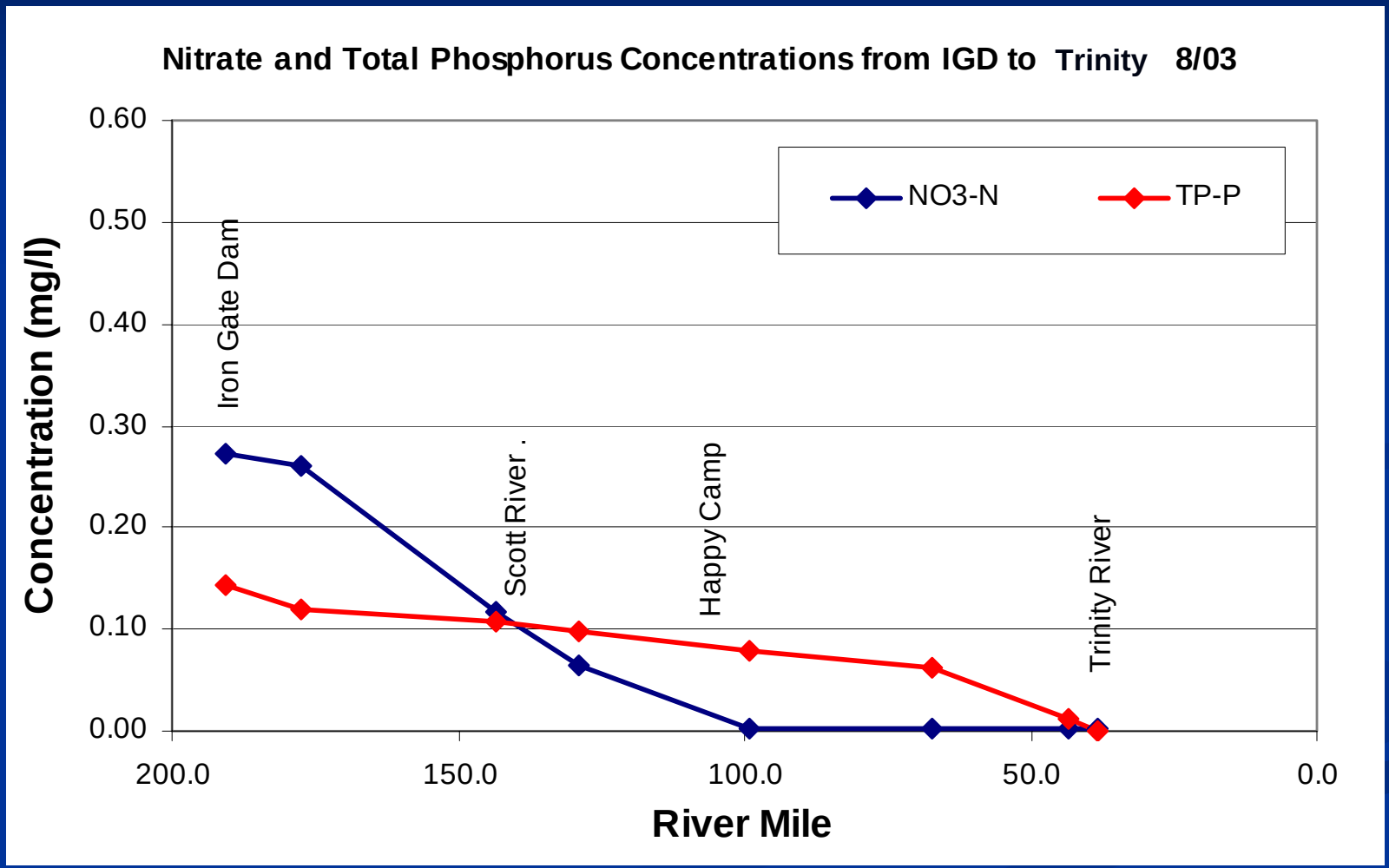


Distribution of the six most common* algal species in August 2004



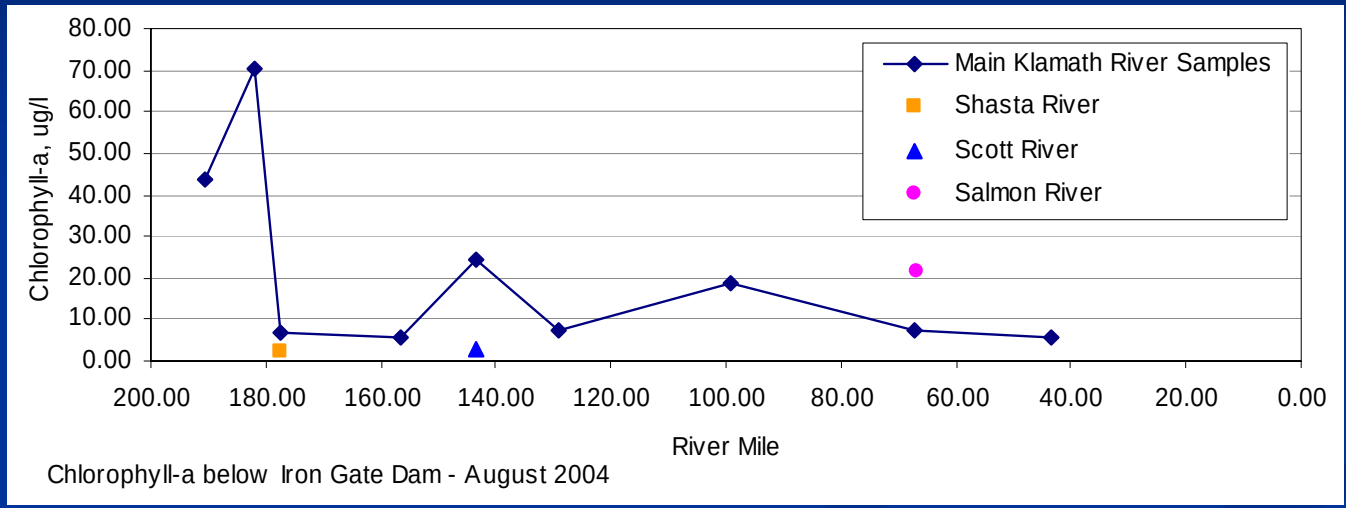
* by percentage density.

Nitrogen and Phosphorus (August 2003*)

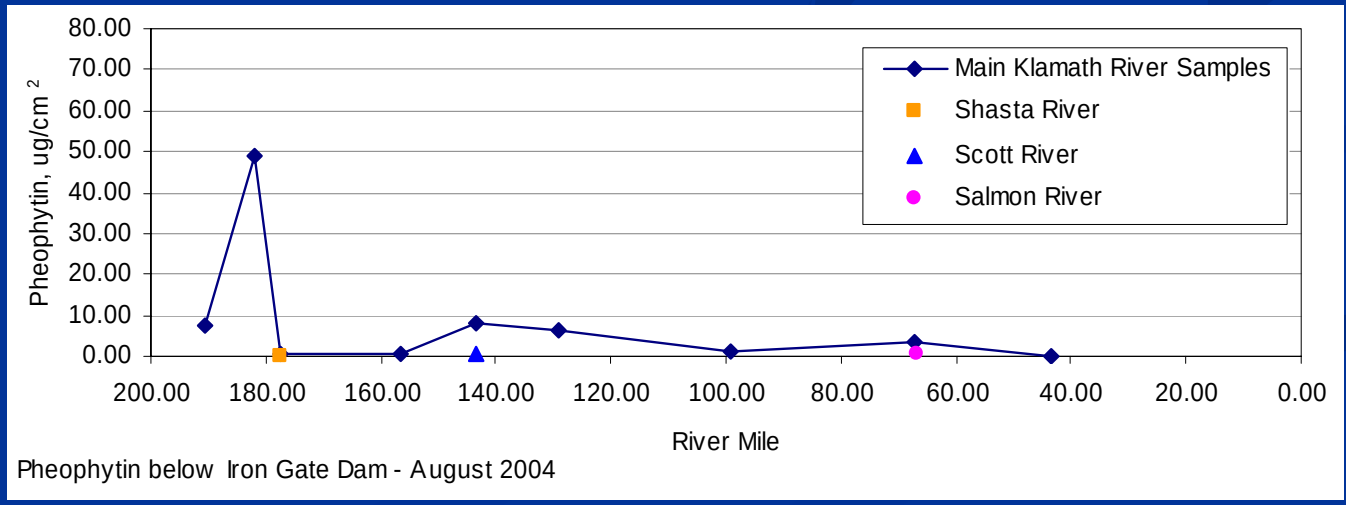


Ammonia non-detect at all sites.

Benthic Algae Iron Gate to Trinity R: Chlorophyll-a and Pheophyton (Aug '04)

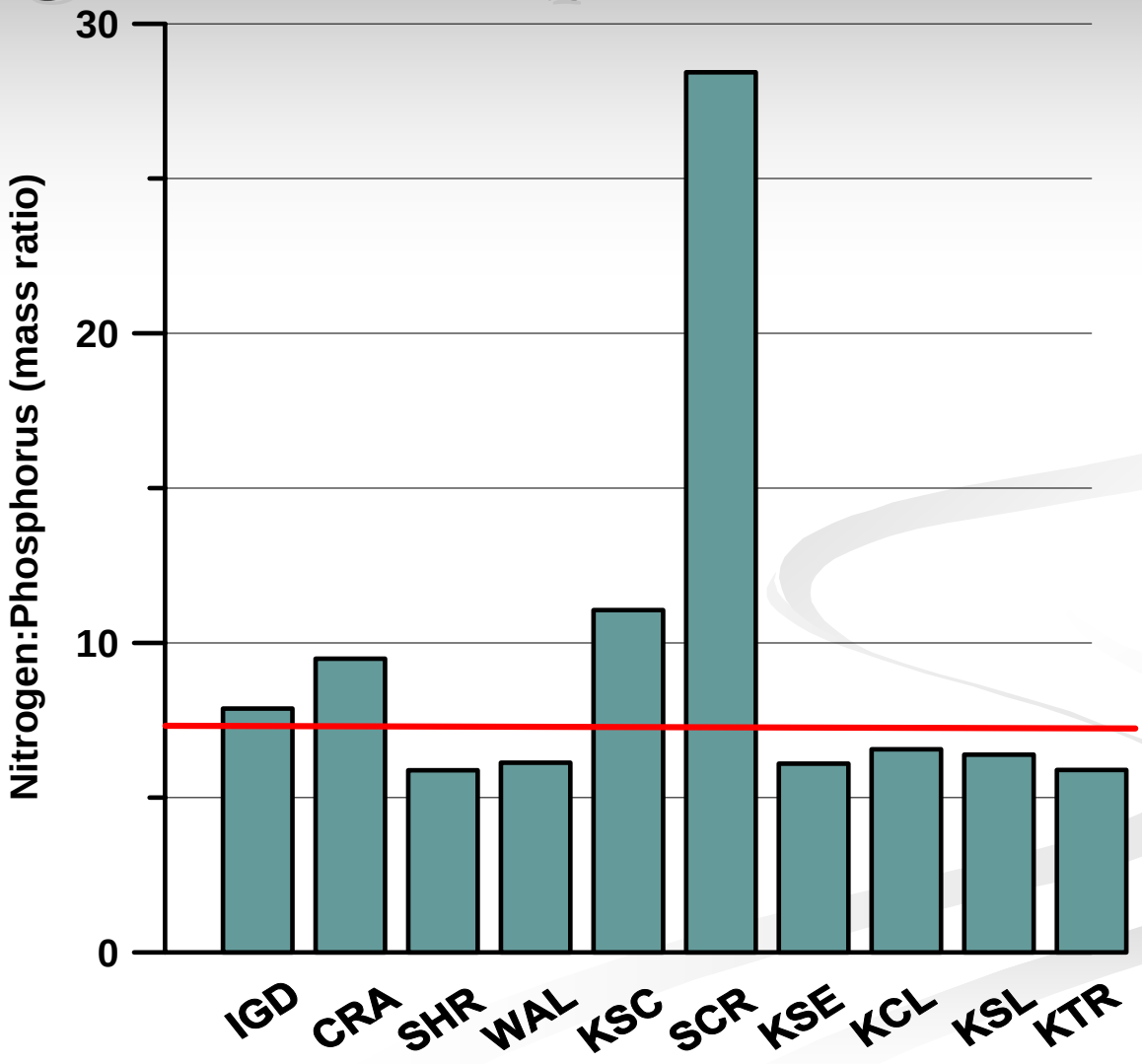


Chlorophyll-a below Iron Gate Dam - August 2004



Pheophytin below Iron Gate Dam - August 2004

Benthic Algae Iron Gate to Trinity R: Nitrogen to Phosphorus Ratio (Sept '04)



Conclusions

- Findings support a common theme of complex and dynamic longitudinal distribution of benthic algae in the Klamath River form Iron Gate Dam to Turwar
- Dominant algal species indicate spatial and temporal variation via
  - Segregation longitudinally
  - Seasonal progressions/transitions
  - Response to environmental factors
    - Nutrients/Chemistry
    - Flow Regime
    - Disturbance
    - Other: light, grazing, competition, water temperature, etc.

References

- *Freshwater Algae of North America: Ecology and Classification*. 2003. eds. Wehr, John D. and Shealth, Robert G. Academic Press.
- *Algal Ecology: Freshwater Benthic Ecosystems* 1996. eds. Stevenson R. Jan, Bothwell, Max L., Lowe, Rex L. Academic Press.
- Patrick, R. and C. W. Reimer. 1966. *The diatoms of the United States, exclusive of Alaska and Hawaii, Volume 1*, Academy of Natural Sciences of Philadelphia. Monograph No. 13.
- Patrick, R. and C. W. Reimer 1975. *The diatoms of the United States, exclusive of Alaska and Hawaii, Volume 2, Part 1*, Academy of Natural Sciences of Philadelphia Monograph No. 13.
- Fore, L. and Grafe, C. 2002. *Using diatoms to assess the biological conditions of large rivers in Idaho* (U.S.A.)
- K.D. Carpenter. 2003. *Water-Quality and Algal Conditions in the Clackamas River Basin, Oregon, and their Relations to Land and Water Management*, Water-Resources Investigations Report 02-4189, United States Geological Survey
- Anderson, C.W. and K.D. Carpenter. 1998. *Water-Quality and Algal Conditions in the North Umpqua River Basin, Oregon, 1992-95, and Implications for Resource Management*, Water-Resources Investigations Report 98-4125, United States Geological Survey